

Land Warrior System 1.0 Overview

Land Warrior is an integrated system, used by the dismounted combat soldier at the tactical level of war.

LW provides the soldier with "Total Battlefield Visibility" through command, control, communications and information sharing at the soldier level.

Land Warrior significantly enhances the soldier's ability to engage and defeat enemy targets while minimizing friendly casualties. LW facilitates dynamic flow of battlefield information and actively supports soldier-level integration into the digitized battlefield.

The LW System is modular

- *To permit tailoring for mission requirements,*
- *To minimize the combat load, and*
- *To streamline maintenance.*

System Description:

The LW System, an integrated soldier-fighting system, enhances the lethality, battle-command compatibility, survivability, mobility, and sustainability of dismounted combat soldiers, enabling them to engage and defeat enemy targets while minimizing friendly casualties. The LW System is modular, to permit tailoring for mission requirements, minimize the combat load, and facilitate maintenance. LW facilitates command, control, and sharing of battlefield information, thus providing "total battlefield visibility" and integration into the digitized battlefield. The system integrates previously distinct components such as protective clothing, communications, sensors, and power, thereby adding enhanced capabilities without adding weight. The LW System includes weapons, sensors, laser rangefinder, displays, integrated load carrying equipment with ballistic protection, protective clothing, helmet, speaker, microphone, computer, navigation, radio, and controls with a consistent and intuitive interface for use under battlefield conditions. These components are integrated into a system that enhances the dismounted combat soldier's lethality, survivability, mobility, command-control-communications, situational awareness and sustainability.

Functions:

Lethality

Quickly and accurately detect, recognize, identify, and record targets.
Vision enhancement, day and night, through thermal imagery, image intensification, and daylight video.
Capability to engage targets, by viewing through the head-mounted display, while exposing hands and arms only.
Function as forward observers for cannon artillery, mortars, and close air support.
Create, transmit, and receive digital fire support messages.
Receive information about in-progress fire missions and fire support plans

Survivability

Ballistic protection from small arms fire and fragmentation hits.
Directed Energy protection and alerts to hostile DE threats.
Signature suppression.
Chemical and Biological protective equipment compatibility.
EMP survivability.
Hostile software detection and neutralization.
Digital calls for medical assistance.

Mobility

Day and night vision enhancement.
Display required travel direction to include waypoints and number of routes.
Map-oriented selection of routes and waypoints.
Integrated Navigation consisting of Global Positioning System (GPS) and Dead Reckoning Module.

Command, Control and Communications

Voice, menu, and alphanumeric inputs.
Audio, video, maps, graphics outputs.
Digital audio and digital messaging.
Individual system access control and tailorable system configuration
Intra-squad communications to transmit/receive voice and data within 1.3 kilometers
Purge sensitive operational data and encryption keys.
Automatic voice retransmission/radio relay between any two radios in the LW Leader configuration.
Active power management.

Situational Awareness

Near-real time responsiveness.

SA database containing information about adjacent soldiers, friendly units, enemy forces, obstacles, and targets.

Display SA data in map and graphics formats.

Automatically-generate position reports.

Map-oriented creation of overlays.

Automatic calculation of route time and leg time, with time remaining.

Enable leaders to plan movements, operations, and fires to produce routes with waypoints, field orders, and overlays.

Situational Awareness (continued)

Process standard warning orders, operations plans, operations orders, and fragmentary orders.

Create, edit, store, delete, transmit, and receive intelligence messages, still-frame video, spot reports and contact reports.

Visual and aural notification for alerts and warnings

Battlefield resource management at squad, platoon, and company levels to include personnel management and logistics management.

Mission Data Transfer

Land Warrior System 1.0 Description Summary August 2001

Major Subsystems/Components:

- **Personal Area Network**
- **Software Architecture and System Products - version 1.0**
- **Head-Mounted-Display Subsystem**
- **Computer Subsystem**
- **Soldier Control Unit**
- **Communication Subsystem**
- **Navigation Subsystem**
- **Weapon Subsystem**
- **Power**
- **Protective Clothing and Individual Equipment**
- **Support Equipment**

LW System Interfaces:

Hardware and Subsystem Interfaces

Weapon Interfaces (Full compatibility with M4 Carbine with/without M203 Grenade Launcher, M16A4, M249 SAW, and M240B Machine Gun. Basic functional compatibility with other small unit individual and crew-served weapons.)

Weapon sensors mounted IAW MIL-STD-1913 interface.

Chemical protective equipment.

Modular Lightweight Load Carrying Equipment system (MOLLE).

Interceptor Body Armor.

Compatible with SINCGARS family of radios.

RS-232 Serial Data Access.

Ethernet Port (10/100 baseT with RJ-45 Connector).

System Software and Data Interfaces

Windows 2000 Operating System.

LW Common Interface

Interoperable with the Tactical Internet.

DII COE and JTA-A compliant.

LW System Supportability:

Weight:

Does not increase the weight of the soldier combat load.

LW components combined with chemical protection gear, weighs less than currently equipped soldier.

Power Sources:

Disposable and Rechargeable Batteries.

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110/220 VAC, 50/60/400 Hz power adapters.

8-28 VDC external power.

Maintenance

Built-in-Test (BIT) to identify failures.

Mean-Time-To-Repair (MTTR) 44 minutes.

Compatible with Two-level Army maintenance and support structure.

Reliability

Mission completion rate (24 hours with a 0.90 confidence level) is 0.85

MANPRINT

Load tailoring of individual modules to adjust balance.
Does not require new MOSSs.

Operations and maintenance by the 5th to 95th percentile male rifle squad soldiers.

Comprehensive help capability.

Consistent and intuitive user interface.

Safety

Certified for US Army Airborne Operations.

Meets UL 1950 and NFPA 70-93.

LW Environmental Characteristics:

Temperature

-32°C to +55°C (-26°F to +131°F).

Vibration and Shock

Parachute Drop Compatible.

Military Transport Modes Compatible.

Water Resistance:

Immersion to 1 meter.

Humidity Up to 100% and Salt Atmosphere.

Altitude

Sea level to 32,000 feet.

EMI

Withstands Electromagnetic Pulse.

TEMPEST certified.

Other Environments

Day and Night, Sand and Dust, Limited Battlefield Visibility, Fungus.

LW V1.0 PAN and System Components Detail:

- LW Personal Area Network (PAN). The LW PAN will serve as the "central nervous system" which integrates the LW components and subcomponents into a cohesive LW system.
- Body Component. This component consists of those subcomponents that are worn on the soldier's body. Primary subsystems include the Computer, the Navigation, the Soldier Control Unit, and the power (batteries) subsystems. In addition the Body Component consists of external interfaces for auxiliary peripherals such as the Hand Held Display (HHD), Keyboard, and Mouse as well as the Leader and SINCGARS ASIP radios where appropriate.
- Helmet Component. This component consists of those subsystems that are mounted on the helmet. Primary subsystems include the helmet mounted display, the audio system (earphone/microphone), the responder for the Combat ID system, and "image enhancement" devices such as image intensifiers, night vision sights, etc.
- Weapon Component. This component consists of the devices mounted onto the weapon.

Personal Area Network

The personal area network (PAN) subsystem provides distribution of power, digital data and analog signals to all components from hubs. The PAN consists of the Body Hub Assembly, Weapon Hub Assembly, and interconnecting cables having eight wires as flex print in a shield. Power, in the range of 8 to 20 VDC, requires 2 wires. Actual voltage depends on the battery type and state of charge or battery eliminator type. Video is transmitted point to point over IEEE-1394a, FireWire, as isochronous data. IEEE-1394a uses four (4) wires and has a peak throughput of 400 Mb/s. Voice is transmitted as isochronous data over USB 1.1. All other digital data and control is transmitted asynchronously over USB, which uses two (2) wires and has a peak throughput of 12 Mb/s. Analog lines are used for RF signals and power-on control from the SCU to the body hub.

Body Component. The LW Body Component includes all those LW elements that are worn on the soldier's body. The LW Body Component includes the following subcomponents:

Connectors and Cable Components. Standard interconnect cables extend from eight standard ports on the Body Hub to the batteries, Computer, Communication/Soldier Control Unit (SCU), Navigation, Helmet, and Weapon Subsystems. A special connector with micro-coax cable extends to the GPS antenna. For the leader version, a standard cable extends to the Leader Radio, Hand-Held Display and keyboard. In line to the weapon and helmet are breakaway connectors for safety. Standard cables extend from the Weapon Hub to the Weapon User Interface (WUI), Daylight Video Sight (DVS), Thermal Weapon Sight (TWS), and Multifunction Laser (MFL).

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Body PAN Hub. The Body Hub contains circuits for control of USB, IEEE-1394, power, and video. Since the LW System must operate with the Computer in standby or inoperative, the body hub contains a USB Open Host Controller. An IEEE-1394 controller and video switch route video signals point to point. A power monitor and FET switches control the distribution of power to the subsystems. If available, a power supply will be connected first, otherwise, the battery with the least remaining capacity is drained before switching to the alternate battery, allowing extended time for replacement of the drained battery. If a short circuit occurs, the power can be switched off to that port. It provides the centralized USB control for the system as well as connectivity to the other primary LW Components (Helmet, Weapon).



Software Architecture Description

The Land Warrior Windows Application architecture provides a modular infrastructure that was developed via the use of object oriented analysis and design (OOD). This architecture is developed to support the following:

- Efficient handling of data through primary data paths that are heavily exercised during normal operations.
- Efficient processing of events triggered both by
 - User actions and requests, made through a device action, (e.g., a button press), or via mouse action on the user interface; and by
 - External stimuli (e.g., a radio message received).

The Land Warrior Windows Application software architecture incorporates lessons learned from the 0.6 Land Warrior Windows Application software development effort which utilized a centralized Land Warrior Server that provided interfaces for direct support of business logic functionality for the presentation layer and communication between business logic components. The primary shortcoming of this approach was the performance limitations imposed by this design. To compensate for these deficiencies, LW V1.0 is utilizing a more distributed architecture with no centralized servers or business logic.

Computer Subsystem.

The primary functions of the Computer Subsystem (CSS) are to allow the soldier to receive, store, display, create, retrieve, edit, delete and transmit various forms of information including:

- Situation Awareness
- Receive incoming message data
- Store/generate maps, images, overlays, messages, and reference material
- Generate/manage map overlays using Graphic Situation Display symbols (MIL-STD-2525B)
- Manage a subset of the Joint Common Data Base (JCDB)
- Message composition and addressing
- Fire Support
- Logistics management
- Personnel management
- Joint Variable Message Format (JVMF) processing and exchange
- Mission Planning
- Receive and generate orders
- Input text and graphics from touch screen and keyboard
- Generate overlays of waypoints, routes and other graphics
 - Access Interactive Electronic Technical Manuals and other reference material
 - Generate alerts and warnings
 - Output video to displays via IEEE 1394 FireWire



The CSS weighs 1.79 pound. It consists of the computer assembly, flash memory and Video Board packaged within the CSS box. The box has a single external

connector to the Personal Area Network (PAN) that contains power, USB and IEEE 1394 FireWire connections. The computer module is a 500 MHz Pentium III "Plug N Run" system. It contains 256 MB of RAM. All external interfaces are in a 320 pin stacking connector. The size is 3 x 5 x 0.7 inches. User interface is through a Soldier Control Unit (SCU) and Helmet-Mounted Display (HMD), however, the leader version includes a Hand-Held Display with touch screen and keyboard. The handheld display shall provide a remote display of the information presented on the head mounted sensor display. The leader system shall also incorporate a QWERTY keyboard to allow for alphanumeric data entry to facilitate the preparation and editing of mission data and C2 messages.

Communications & Networking.

The Land Warrior v1.0 communications system includes a soldier radio, leader radio, antenna component and power amplifier. This is comprised of a wireless local area network (WLAN), as part of the Soldier Control unit (SCU), and serves as the intra-squad/platoon/company means of communications among dismounted infantry. It provides for digital voice and data communications over the WLAN, and receives/transmits by means of Voice Over Internet Protocol (VOIP) and IP data, adapting a commercially available, standard IEEE 802.11b WLAN card that has been repackaged and down converted from its typical 2.4 GHz to the military band of 1.8 GHz. The antenna and power amplifier are part of the Helmet Integrated Assembly.

For the Land Warrior extended range communications, especially the leader, v1.0 incorporates a leader radio component. The Multi-band Inter/Intra Team Radio (MBITR), as known as the AN/PRC-148, is provided as a Government furnished end item. It is a portable, battery operated, transceiver capable of providing both secure and non-secure communications for Land Warrior leaders from the small unit squad leader to company commander, and facilitate extended range communications for certain mission areas such as the medic or forward observer. THE MBITR is also in development to serve as the communications and network gateway for Land Warrior Tactical Internet connectivity into the Army's Battle Command Systems.

Navigation Subsystem.

The Navigation Subsystem (NAVSS) provides position and navigation information for the LW system. It consists of Global Positioning System (GPS) and a navigation aids known as the Dead Reckoning Module (DRM). Both are integrated within the NAVSS, which is interfaced to the LW system via the USB bus. A shoulder-mounted antenna is also provided for GPS. The NAVSS directly enhances the Situation Awareness and Mobility of the Land Warrior equipped unit. Situation Awareness is facilitated via the NAVSS's automatic determination of soldier position, which is periodically broadcast to friendly units. Mobility is increased through the electronic maintenance of soldier position and heading, which is used to feed navigation information, such as required direction of travel, on the LW display.

Soldier Control Unit (SCU). The SCU provides a user identification capability, soldier interfaces controls to the LW system, and individual soldier communications.



The SCU is provided as a convenient user input device, mounted on the chest, to control the system power, operate the Computer Subsystem, and provide an inductive coupling to a Soldier Access Module for logging onto the system and loading user data. User inputs include a 2-button mouse, two push-to-talk buttons, on/off switch, radio volume control, and brightness control for the Helmet-Mounted Display. User inputs are encoded and sent over the USB portion of the Personal Area Network to other subsystems. It also interprets user inputs from the Weapons User Interface and operates the system in absence of the Computer Subsystem.

The Communication Subsystem (CommSS) provides non-secure voice and data communications for the LW system. Soldier communications within a squad are required up to a range of 1.3 km. A Commercial Off-The-Shelf (COTS) solution was chosen which consists of these main components:

- An IEEE STD 802.11b Wireless Local Area Network (WLAN) in a PC card using the Harris PRISM-II chipset,
- A TMS55C10C digital signal processor running Broadcom xChange Voice over Internet Protocol (VoIP) libraries and audio signal processing,
- A StrongARM SA-1110 processor with 64 MB DRAM and 32 MB Flash memory running the headless Windows CE 3.0 operating system to provide communications control and user interface input control. And,
- A Soldier Access Module (SAM) Device "Smart Card", that provides the capability for reading a modified COTS RF Card.

Helmet Subsystem.

The Helmet Component implements the hands free display, the audio headset/microphone and the electronics associated with these components. In addition the Helmet incorporates a variety image enhancing systems. Balanced and optimized for the LW assault helmet, the LW v1.0 helmet subassemblies consists of:

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- Helmet-Mounted Display (HMD)
- Helmet Interface Assembly (HIA)
- Radio Antenna assembly
- Audio headset

The HMD is an 800x600/640x480 color display using self emissive, Organic Light Emitting Diode (OLED) technology. The display's optics is a high efficiency plastic prism encased in a protective housing. The HIA drives the video electronics and provides for all helmet-borne electronics connectivity and processing. It performs function control and video processing as well as display signal operations, and power amplification of WLAN radio transmissions. It is located onto the rear of the assault helmet. The radio antenna assembly provides for individual soldier communications over the WLAN radio incorporated into the SCU. Included is a metal ground plate to optimize antenna performance and RF emission protection. It is a flat disk-shaped object located onto the top of the assault helmet. The audio headset is a modified COTS product consisting of an integrated speaker/mic attached to the inner part of the assault helmet of either ear. Soldier voice communications and radio listening are accomplished with this device.



Note that current legacy electronics components installed on the helmet are compatible with the LW v1.0 helmet subsystem and can co-exist among its components (e.g., AN/PVS-14 Night Vision Goggles, I2 devices, Protective Eyewear, Chemical Mask)

Weapon Subsystem.

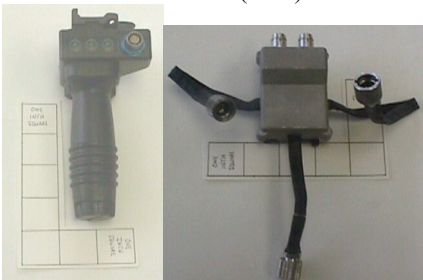
The Weapons Subsystem (WSS) integrates the electronic devices and sensors mounted onto select, modular weapons used by the dismounted infantry, to include the M4 Carbine with or without the M203 Grenade Launcher, M16A4 rifle, M249 SAW, and M240B Machine Gun. The Weapon Subsystem (WSS) components consist of the following:

- Thermal Weapon Sight (TWS)
- Multi-Function Laser (MFL)
- Daylight Video Sight (DVS)
- User Interface Device (UID)
- Weapons HUB

The TWS provides night viewing capability as well as day operations through obscurants. There are two variants of the TWS to be developed for LW V1.0: The AN/PAS-13 Medium TWS (MTWS) and the Light TWS (LTWS). Both the MTWS and LTWS will transmit video via the legacy RS-170 analog standard. Both TWSs are controlled and viewed through the LW system, yet either TWS is also capable as a stand-alone device, independently controlled and with direct view in the absence of the system.

The MFL incorporates laser range-finding, digital compass, visible and IR pointing, and IR illumination capabilities. This level of functions replaces the use of the existing stand-alone PEQ-2 and PAQ-4 devices, into a combined device that is controlled on the USB network. Effective range is 1500 meters NATO-sized target specification.

The DVS provides high-resolution day imagery that will be transmitted via the IEEE 1394 Firewire sub-network, with DVS control implemented via the USB network. The DVS allows for indirect viewing onto either helmet or handheld display components User Interface Device (UID).



The UID provides operator controls for the MFL, push to talk (PTT) over radio, and video selection (DVS, TWS, Computer). The UID is located on the lower rail of the M-4 and M-249 weapons (but on the right rail of the M-203 when installed), and on the rear stock of the M-249.

The Weapons HUB provides central access of IEEE 1394 and USB signals for the WSS components and is the central link to the Body Hub and PAN.

Note that current legacy components installed on their respective weapons (M4, M16, M203, M249, M240) are compatible with the LW v1.0 WSS and can co-exist among its components (e.g., Close Combat Optic, Machine Gun Optic)

Power Sources.

Disposable Batteries – A disposable, high capacity, 2 pound, 16V nominal, Li/MnO₂ pouch cell battery provides 13.5Ah of capacity and 215Wh of energy for the Land Warrior System. This battery is a SMBus1.1 compliant smart battery, providing the system with an accurate fuel gauge and data for end of use or “end of life” disposal. At an average system power draw of 18W, this battery will provide 12 hours of operation at 24 degrees C. Manufacturers of this battery are Ultralife Batteries and Eagle Pitcher. The Li/MnO₂ pouch cell technology provides twice the capacity of the Li/SO₂ chemistry currently used in Army disposable batteries.

Rechargeable Batteries - Two rechargeable batteries are available. One is a 1.5 lb., 15V nominal, Lithium-ion battery that provides a capacity of 5.5Ah and energy of 80Wh. At an average system power draw of 18W, this battery will operate the system for 4.5 hours at 24 degrees C. The other is a 2 lb, 15V nominal, Li-ion battery that provides 7Ah of capacity and 110Wh of energy. At 18W, this battery will provide 6 hours of operation at 24 degrees C. Both batteries are SMBus1.1 compliant smart batteries, providing the system with an accurate state-of-charge indication and data for “end of life” disposal. Manufacturers for the 1.5lb and 2.0lb rechargeable batteries are SAFT (LI5.5) and Brentronics, respectively.

Individual Charger – A single channel, pulse technique charger recharges one each of the above rechargeable batteries in approximately 4 hours. Operates from 110VAC/220VAC or 28VDC power sources. Today, it is manufactured by PATCO Electronics, however this capability will be satisfied by an adapter to the the PP8444/U Standard Army Charger, once LW is fielded.

Bulk Charger – A 40 channel, SMBus1.1 smart charger that recharges a fully drained battery in 3 hours. IT can recharge upto 40 LW batteries simultaneously and is portable enough to be sourced from a building or vehicle on the move. It requires 220VAC or 28VDC, and is manufactured by Coastal Marine Research.

IAV Charger – A special purpose, 9 channel, SMBus1.1 smart charger that recharges a fully drained battery in 3 hours. Manufactured by Brentronics. It requires 28VDC for its specific use to provide a recharging station for up to nine LW equipped soldiers who, once fielded, will someday utilize the Army’s Interim Armored Vehicle (IAV) for dismounted operations.

Support Equipment

Mission Data Support (MDS) Computer

The LW MDS Computer shall provide the primary source of digital mission information used by Land Warrior Systems. It shall be used to generate, maintain, and transfer the Mission Data Packages (MDPs) that contain the critical information required to enable LW-equipped soldiers to conduct a specific mission. MDPs shall consist of digital maps, overlays, Operations Orders, Unit Task Organization (UTO) data, images, logistics authorizations data, unit-generated help documents in Hypertext Markup Language (HTML) and technical reference materials. The MDS shall also prepare and edit Soldier Access Modules (SAMs) cards.

The MDS software shall be employed on a CHS computer that is located in the company headquarters and primary staff sections at the battalion/task force main command post and in the battalion/task force trains area. The system(s) in the main command post area shall be used by the communications section, S2 staff section, and S3 staff section to extract maps, to edit MDP data components, to prepare MDPs, to transfer MDPs to representatives from organizations within the battalion task force, and transfer Operations Order data.

Maintenance Computer

The Maintenance Computer is used to facilitate LW DS and depot level maintenance and repair actions. Its primary functions include:

- LW software, firmware, and documentation update distribution, loading, and tracking;
- Virus-checking,
- Electronic flash disk recovery (repair); and
- Provide screening and limited diagnostic capabilities in support of LW system maintenance at the Battalion and Direct Support Maintenance locations.

Land Warrior System Architecture Version 1.0 for DT

